

### **REMARKS**

Applicants hereby request further consideration of the application in view of the amendments above and the comments that follow.<sup>1</sup>

Applicants wish to thank the Examiner for the telephone interview with Applicant's attorney, David Beatty, on May 23, 2007. In order to complete the prosecution record, Applicants respectfully note that the Interview Summary dated May 25, 2007 regarding the interview with Examiner Dhingra on May 23, 2007 reflects the substance of the interview but is incorrect in part. During the interview, Applicants proposed amending Claim 5 to add limitations pertaining to supply of electromagnetic energy to the susceptor (not to "the reactor coil" as stated in the Interview Summary).

### **Status of the Claims**

Claims 1-12 are pending the present application. Claims 1, 2, 5-7 stand rejected under Section 103(a) as being anticipated by U.S. Patent No. 6,709,520 to Leycuras (Leycuras) in view of U.S. Patent No. 6,740,167 to Rupp et al. (Rupp). Claims 3, 8, 9 stand rejected under Section 103(a) as being unpatentable over Leycuras in view of Rupp and further in view of U.S. Patent No. 3,845,738 to Berkman et al. (Berkman). Claims 4 and 11 stand rejected under Section 103(a) as being unpatentable over Leycuras in view of Rupp and further in view of U.S. Patent No. 5,667,587 to Glass (Glass). Claim 10 stands rejected under Section 103(a) as being unpatentable over Leycuras in view of Rupp and Berkman and further in view of U.S. Patent No. 6,569,250 to Paisley et al. (Paisley). Claim 12 stands rejected under Section 103(a) as being unpatentable over Leycuras in view of Rupp and further in view of U.S. Patent Publication No. 2001/0046768 to Mezey (Mezey).

### **The Rejections Under Section 103**

Claim 5 stands rejected under Section 103 over Leycuras in view of Rupp. Claim 5 recites:

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1. Applicants note that, on the cover sheet of the Action, both the final and non-final status blocks are checked in Section 2a). Because the Action itself does not state that the Action has been made final, Applicants understand the Action to be non-final. If Applicants' understanding is in error, Applicants respectfully request that the Examiner inform the undersigned.

5. A heating device comprising:
  - a housing assembly defining a processing chamber and including:
    - a susceptor surrounding at least a portion of the processing chamber; and
    - a thermally conductive liner interposed between the susceptor and the processing chamber, wherein the liner is separately formed from the susceptor;
      - wherein the susceptor includes a susceptor core of a first material and a susceptor coating of a second material;
      - wherein the second material is selected from the group consisting of refractory metal carbides; and
      - wherein the liner is interposed between the susceptor coating and the processing chamber; and
    - an EMF generator configured to generate an electromagnetic field to induce eddy currents within the susceptor, wherein the susceptor converts the eddy currents to heat.

An exemplary housing assembly **100** is disclosed in Applicant's specification. The housing assembly **100** may provide for a more efficient, convenient and durable heating device, particularly where a refractory metal carbide such as TaC is used for the coatings **117**, **127** on the susceptor cores **115**, **125** and SiC is used for the coatings **137**, **147**, **157**, **167** on the side susceptor cores **135**, the platter core **145**, and the liner cores **155**, **165**. The TaC coatings **117**, **127** may serve to reduce thermal radiation losses and prevent or reduce undesirable sublimation of the SiC coatings. The TaC coating in the platter region **112** of the bottom susceptor **110** may provide a more durable platform for the rotating platter **140**. The provision of the SiC coatings in fluid communication with the passage **102** and in the vicinity of the substrate take advantage of the adherent nature of parasitic SiC deposits to the SiC coatings and the chemical, thermal, mechanical, and structural similarity of the SiC coatings and the SiC substrate **5**. The SiC coatings **137** on the side susceptor members **130** may assist in reducing the heating of the side susceptors due to induction heating.

The Action cites the duct **6** of Leycuras as corresponding to the claimed susceptor. In Applicants' prior response, Applicants noted that the duct **6** is not a susceptor as intended. In response, the Action states:

Examiner responds that in Leycuras reference, duct 6 is used to transfer heat to substrate 10, that is "absorbs externally supplied energy and re-transmits the same to a substrate" and is thus functioning as a susceptor.

During the interview, the Examiner explained that the term "susceptor" was sometimes used to refer to components that are not inductively heated as disclosed by Applicants and suggested that Applicants amend the claim to clarify the nature of the claimed "susceptor". Claim 5 has been amended to further distinguish the claimed heating device from the apparatus of Leycuras<sup>2</sup>. In particular, the duct 6 of Leycuras is merely a thermally conductive liner. Leycuras does not teach or suggest the provision of an electromagnetic field (EMF) generator that generates an EMF field that induces eddy currents in the duct 6, which eddy currents the duct 6 converts to heat. As such, the duct 6 is fundamentally different in purpose and function than the susceptor as recited in Claim 5. Thus, the coating to which the Action refers is not a coating on a susceptor that corresponds to the susceptor as now recited in Claim 5. Accordingly, the cited art fails to disclose this aspect of the application as claimed.

The Action further states:

Further, Leycuras also teach that heating means can be inductive heating means, and thus duct 6 functioning as a susceptor could be heated by induction means as per claim limitations.

Applicants submit that the passage of Leycuras at col. 8, line 62 to col. 9, line 4 cannot properly be regarded as teaching or suggesting the invention as recited in Claim 5 as now amended. Per Leycuras, the process chamber heat is generated by first and second heating means 8, 9, not the duct 6. *See, e.g.*, col. 5, lines 37-49. While Leycuras suggests that the heating means 8, 9 may be "induction heating means" (*see* col. 8, line 62 to col. 9, line 4), there is no apparent suggestion to use the duct 6 as an EMF-to-heat converting susceptor of an induction heating device. Rather, the ordinarily skilled artisan without benefit of Applicants' specification would interpret the cited disclosure to suggest that the resistive elements 8, 9 would be replaced with an EMF generator and susceptors, and the duct 6 would still be only a thermally conductive element heated by the susceptors of the heating means 8, 9, not a part of the first and second heating means.

Moreover, the use of the duct 6 as a susceptor that converts an EMF to heat is nonobvious and unlikely for at least two reasons. First, this would essentially eliminate the heating means 8, 9 and incorporate their functionality into the duct 6. Yet, Leycuras does not suggest doing that by eliminating the electrically, resistive elements 8, 9 and making the duct 6 an electrically resistive heating element. Thus, Leycuras only contemplates using the duct 6 as an element that is heated by thermal transfer, not an element that converts electrical energy to heat. The duct 6, interposed between heating elements and the process chamber, appears to be a critical and necessary element of the Leycuras invention (*see, e.g.*, Leycuras at col. 2, lines 17-29). In fact, the background discussion of Leycuras appears to teach away from the use of the duct 6 as an EMF-to-heat converting susceptor (*see, e.g.*, col. 1, lines 22-48).

Second, using the duct 6 itself as a susceptor that converts an EMF from an EMF generator to heat is clearly at odds with the intended functionality of the heating means 8, 9. The duct 6, by design, extends well beyond the deposition zone in either direction. The heating means 8, 9, by contrast, extend only along a more limited region about the deposition zone. Utilizing the duct 6 as an induction susceptor would presumably undesirably alter the thermal distribution provided and/or introduce complexity. *See, e.g.*, Leycuras at col. 5, lines 37-39 and 45-59, col. 1, line 66-col. 6, line 2, and col. 6, lines 24-26.

Regarding the combination of Leycuras and Rupp, the Action states:

Rupp et al teach an apparatus (Figures 1-4) for processing wafers comprising a susceptor 1 that has an insert 2 for supporting a semiconductor substrate 3. Rupp et al further teach that insert 2 has a core 11 made from graphite, and it is then coated with a metal carbide layer 6 made from metals like tantalum, niobium etc (refractory metals) [column 2, line 35 to column 3, line 20 and column 4, line 45 to column 5, line 52].

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use a susceptor with a graphite core material and coated with a carbide coating of refractory metals like TaC, as taught by Rupp et al in the apparatus of Leycuras to obtain susceptor that is stable at high temperatures and also does not introduce any impurity into the wafer during processing (column 5, lines 2-17).

Although Rupp does disclose a layer 6 of metal carbide on an insert 2, it does not teach or

suggest the aspect for which it is cited and, in particular, Rupp does not suggest the modification to Leycuras proposed by the Action. The insert 2 of Rupp interfaces with the process chamber or gas stream and is not covered by a liner. Thus, Rupp does not suggest the use of a coating of a refractory metal carbide on a susceptor core, wherein a liner is interposed between the coating and a processing chamber. Moreover, Rupp teaches nothing with respect to materials for use in coating a susceptor core separated from a processing chamber by a liner.

Leycuras itself does not teach or suggest the claimed invention or the proposed modification in view of Rupp. The Action contends that, by teaching that the inner surfaces of the walls 37, 38 of the duct 6 can be coated, Leycuras teaches that the plates 70 will be interposed between this coating and the processing chamber. Even if, *arguendo*, Leycuras is understood to teach or suggest the provision of both a coating and the plates 70 (*i.e.*, the secondary duct), the suggested coating is "a prior coating of the material intended to be deposited on a substrate 10 in this reactor... so as to minimize the diffusion of any outgasing substances during the normal operation of the reactor 1" (Leycuras at col. 4, lines 45-53; emphasis added). Thus, it may be expected that the coating of Leycuras would be a coating of SiC or AlN, not a metal carbide, and Leycuras arguably teaches away from the proposed modification.

Regarding the proposed motivation for modifying Leycuras in view of Rupp, the insert 2 supports the wafer 3 and the ordinarily skilled artisan would therefore regard the insert 2 as corresponding to the substrate holder 29 of Leycuras, not the duct 6. Rupp is directed to a susceptor as a support for a substrate (*see, e.g.*, Rupp at col. 1, lines 12-15). The metal carbide layer 6 is intended to prevent contaminants from diffusing into the substrate via the contact between the substrate and the surface supporting the substrate (*see, e.g.*, Rupp at col. 2, lines 1-5 and lines 51-57, col. 3, lines 7-13, and col. 5, lines 44-47). Accordingly, the insert 2 of Rupp has no apparent correspondence or relation to the duct 6 of Leycuras, which is separated from contact with the substrate 10 by not only the substrate holder 29, but also the liner 70.

In view of the foregoing, Applicants respectfully submit that Claim 5 is patentable over the cited art. Claims 1-4 and 6-12 depend from Claim 5 and are therefore allowable for

at least the foregoing reasons. At least certain of the dependent claims are further distinguishable from the cited art, as follows.

Claim 12 depends from Claim 5 and further recites that "the liner includes a portion formed of SiC interfacing with the processing chamber." This recitation further distinguishes the claimed invention from the proposed combination of Leycuras and Rupp (Rupp teaches that the metal carbide layer 6 interfaces with the process chamber). Claim 12 is separately rejected under Section 103 over Leycuras in view of Rupp and further in view of Mezey. The Action states:

Leycuras in view of Rupp et al does not explicitly teach that liner is made from silicon carbide.

Mezey teach an apparatus for semiconductor processing (Figure 1) comprising:

A housing 30 defining a processing chamber and a heat shield 70 (liner) that interfaces with the processing chamber and is made from silicon carbide (paragraphs 0033-0050).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use liner made from silicon carbide as taught by Mezey in the apparatus of Leycuras in view of its being an equivalent refractory material.

Applicant respectfully disagrees. The heat shield **70** of Mezey does not interface with the process chamber (*i.e.*, the process zone contained within the process chamber **54**; *see*, Mezey at paragraphs [0035-0036]). Mezey does not satisfy the deficiencies as discussed above with regard to the rejection of Claim 5 over Leycuras in view of Rupp.

**CONCLUSION**

Applicants submit that the present application is in condition for allowance and the same is earnestly solicited. Should the Examiner have any matters outstanding of resolution, he is encouraged to telephone the undersigned at 919-854-1400 for expeditious handling.

Respectfully submitted,



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